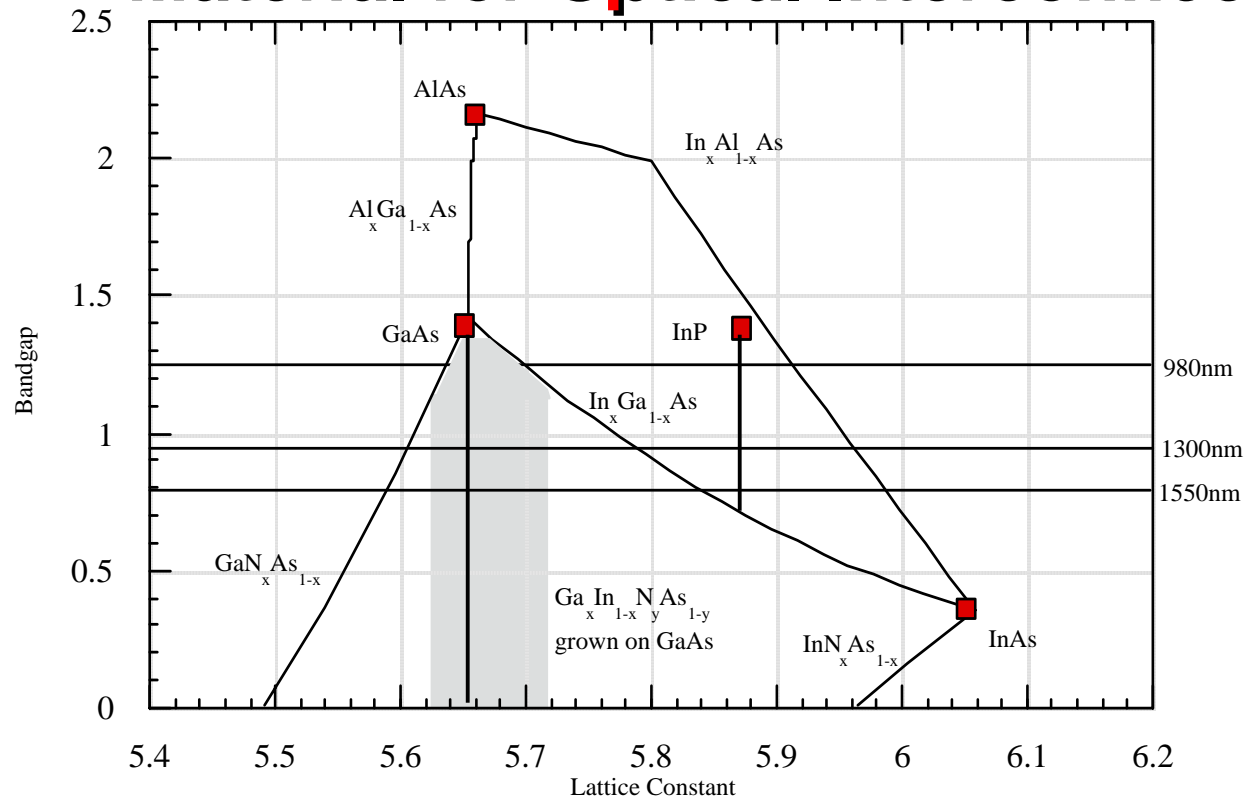




# GaInNAs, a Long Wavelength, Low Voltage Material for Optical Interconnects



- Scaled CMOS compatible (<1V)
- Si substrate transparent
- Applicable to modulators, VCSELs and detectors
- Compatible with telecommunications wavelengths

J. Harris



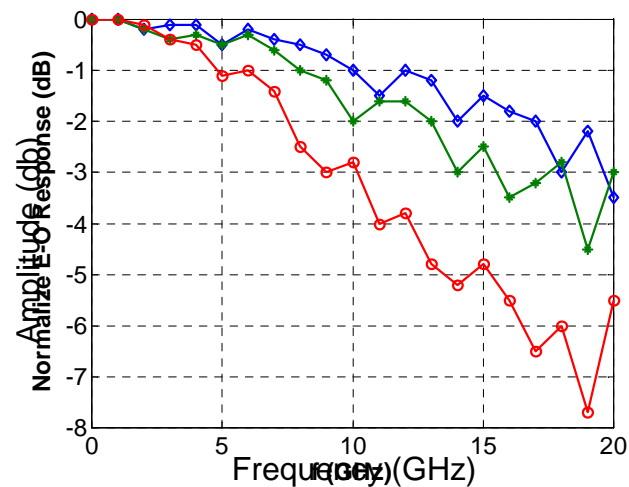
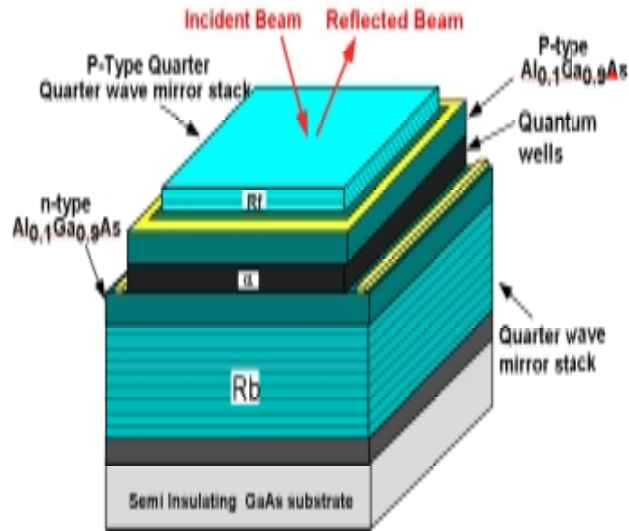
High Capacity  
Optoelectronic  
Interconnects

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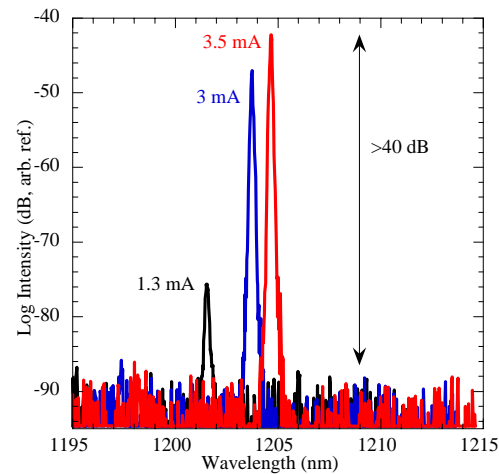


# Long Wavelength Devices for Si CMOS Integration

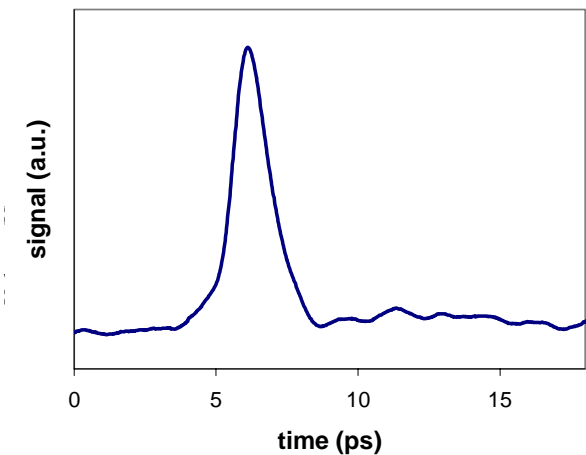
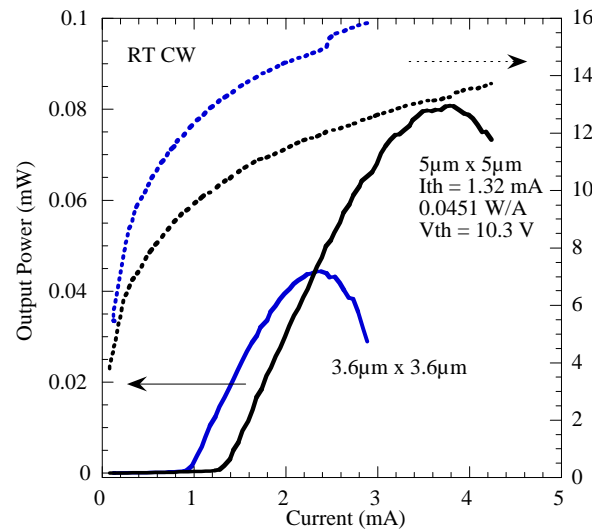
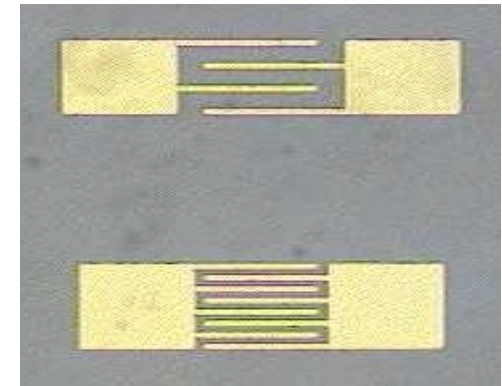
Quantum Well Modulator



VCSEL



MSN Photodetectors



Approved for public release, distribution unlimited

J. Harris & D. Miller



# Selective Area Epitaxy for Integrated Laser/Modulator Modules

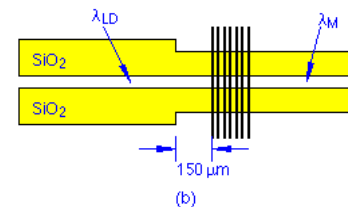
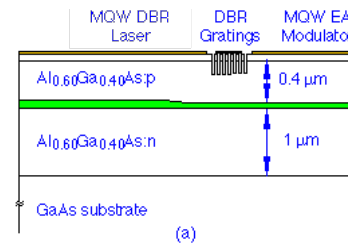
## Objectives

- Monolithic integrated microelectronic-photonic systems for 10-100 GHz spectrum analysis
- Integrated on-chip generation, splitting, routing, modulation, heterodyning, and filtering of optical signals

## Approach

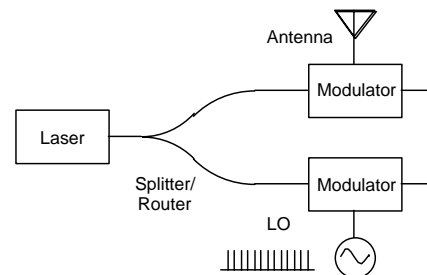
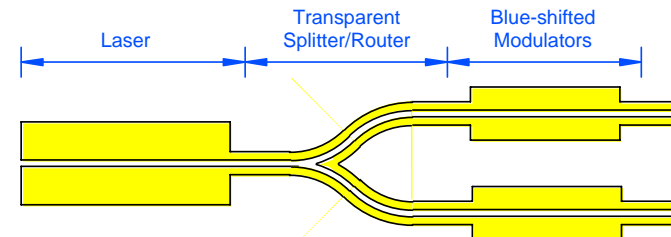
- Selective-area MOCVD growth of engineered bandgap structures using a patterned oxide mask
- DBR diode laser master oscillator, slightly blue-shifted electroabsorption modulators, heavily blue-shifted (transparent) splitter and router waveguides

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Selective-area epitaxy (SAE) tunable narrow linewidth laser/electro-absorption modulator

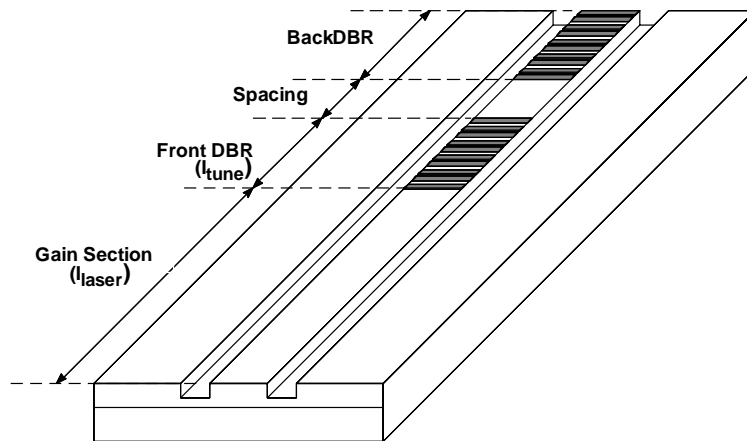
SAE oxide mask pattern



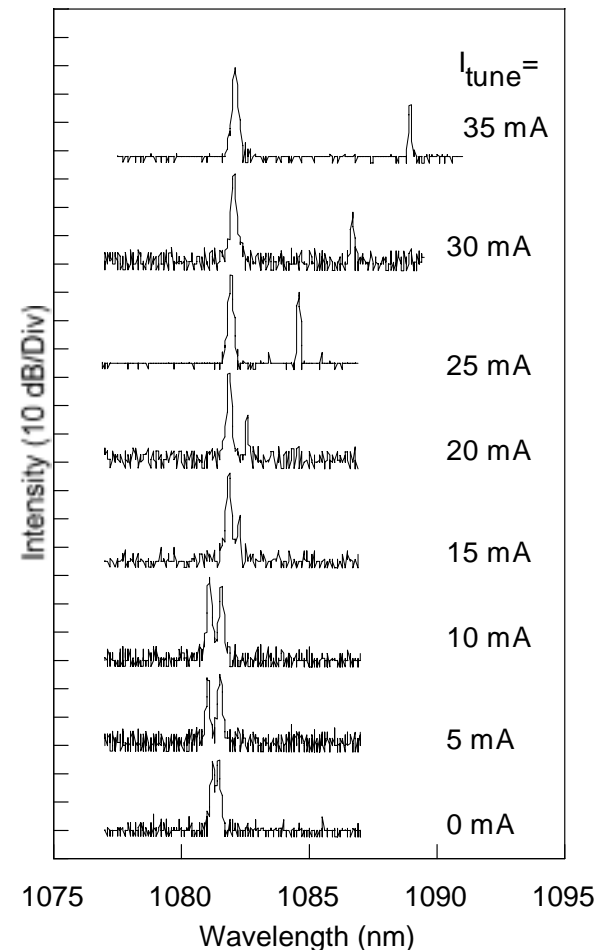
SAE laser integrated with a splitter/router and dual modulators



## Dual-Wavelength Ridge Waveguide DBR Lasers with Tunable Mode Separation



- Common gain section and two separate DBR sections
- Relatively low coupling coefficient  $\kappa$ , in the front grating reduces the added cavity loss for the back grating mode
- Biasing the front DBR section results in tunable mode pair separations ( $\Delta\lambda$ ) as small as 0.3 nm and as large as 6.9 nm



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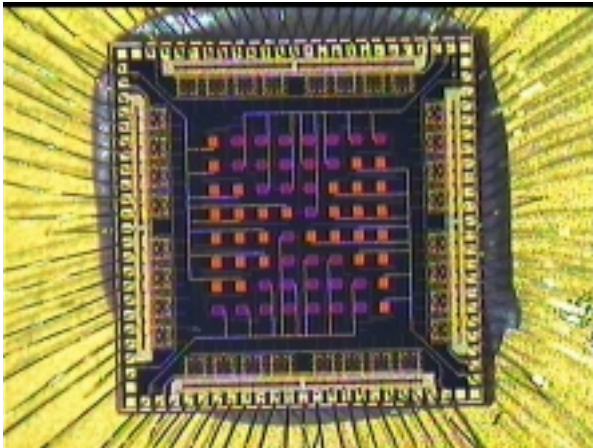
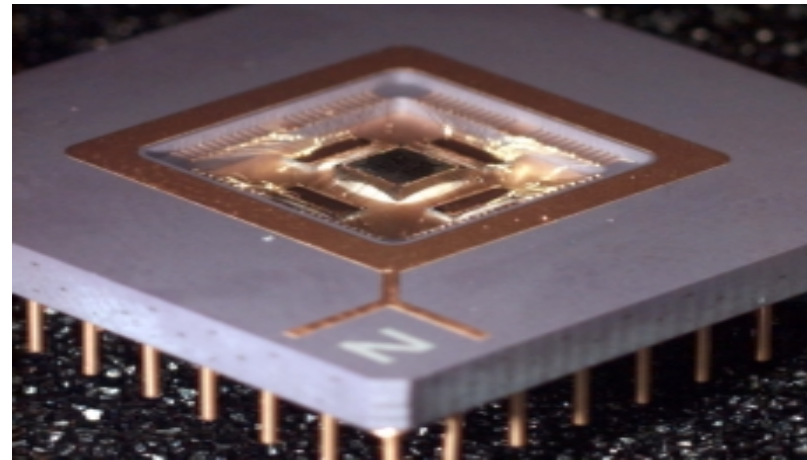
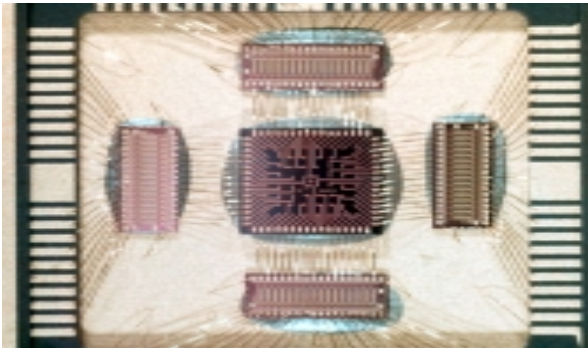
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## 8x8 Parallel Channel Receiver and Transmitter



Objective: high aggregate rate short range optical data links.

K. Choquette





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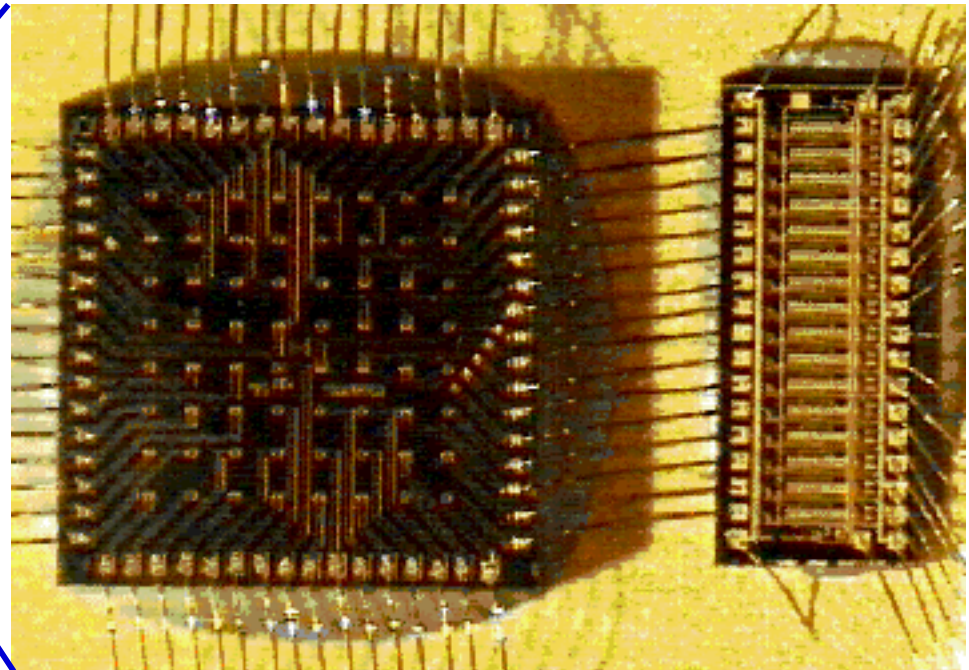
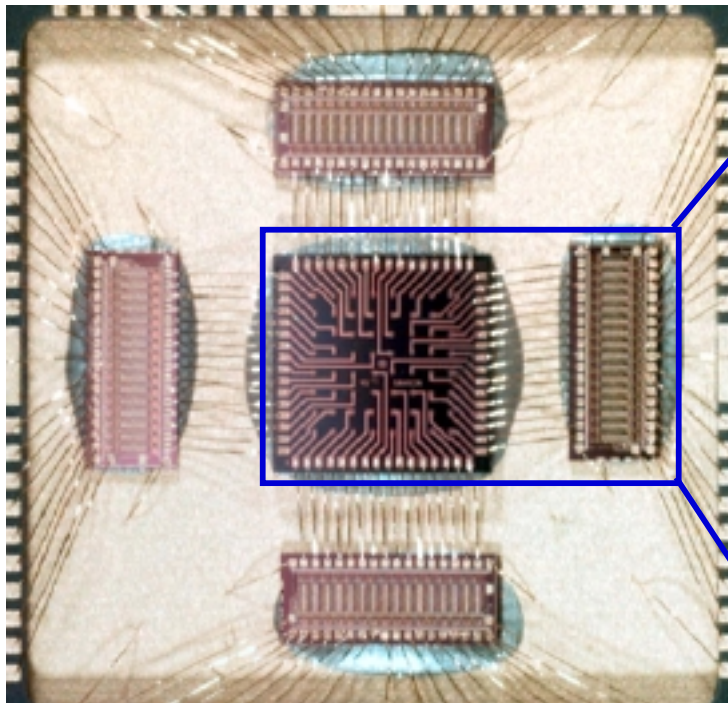


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## Hybrid Packaged VCSEL/Driver Arrays

- 8x8 selectively oxidized 850 nm VCSEL array
- Four 16-channel MESFET driver arrays
- Wirebonded into 84 pin PGA package

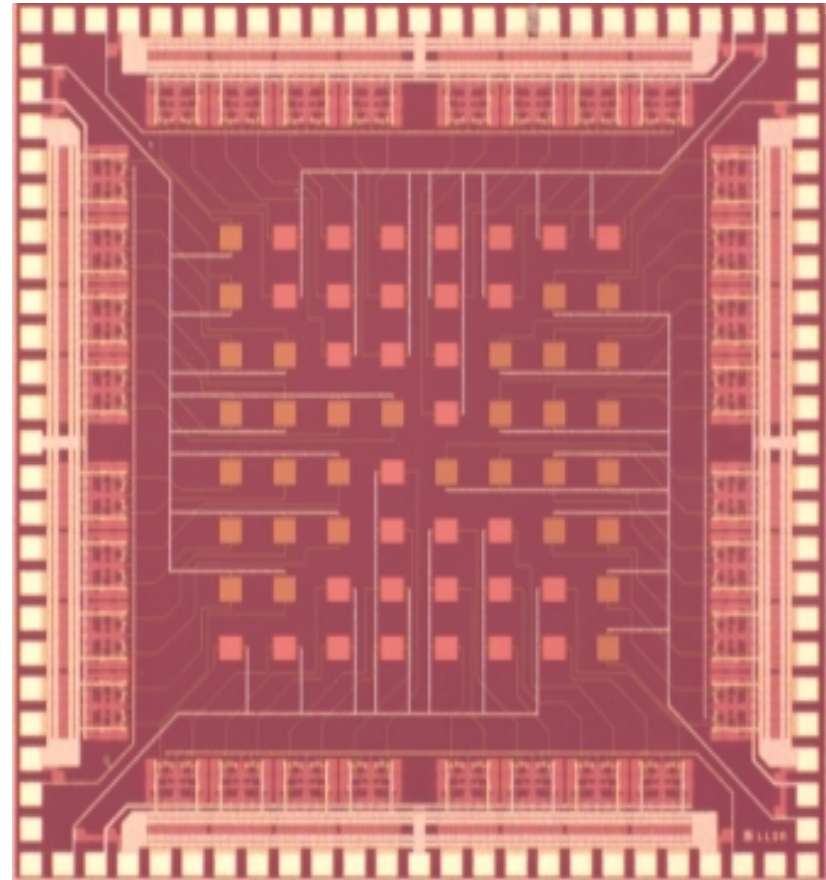


K. Choquette



## Monolithic 8x8 Array Photoreceiver

- 8x8 MSM detector array which matches the VCSEL array.
- 64 trans-impedance amplifiers are integrated on the periphery.
- Total power dissipation less than 2 W @ 3V.
- Uses GTL output level.
- MSM detectors integrated into a standard commercial GaAs MESFET process.



K. Choquette